IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Surya Prakash, et al. Art Unit : 1745
Serial No.: 09/489,515 Examiner : J. Mercado
Filed : January 21, 2000
Title : MEMBRANE ELECTRODE ASSEMBLY FOR A FUEL CELL

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Applicants herewith file this appeal brief under Rule 41.37, thereby perfecting the notice of appeal that was originally filed on August 11, 2006. The sections required by Rule 41.37 follow.

BRIEF ON APPEAL

(1) Real Party in Interest

California Institute of Technology is the real party in interest of this application.

(2) Related Appeals and Interferences

There are no known related appeals and/or interferences.

(3) Status of Claims

Claims 19-22, 24-27 and 20 9-33 are pending in the case. Each of these claims are rejected, and each of these claims are herewith appealed.

(4) Status of Amendments

The amendment after final was filed on July 5, 2006. This was entered in an advisory action dated August 4, 2006.

(5) Summary of Claimed Subject Matter

Claim 19 defines a catalyst ink with a catalytic material that has a liquid copolymer of tetrafluoroethylene and perfluorovinylether sulfonic acid. This is described from page 4 of the specification line 23 through page 5 line 10. The catalyst ink is applied to a membrane, see page 5 lines 7-9 and that is bonded to an electrode. See page 6 lines 19-24.

Claim 26 defines a catalyst ink with poly(vinylidene fluoride) and a liquid copolymer, see page 4 lines 23 through page 5 line 10. This is applied to a membrane see page 5 line 7-9 and bonded to an electrode, see page 6 line 19 through page 6 line 24.

Claim 27 defines providing a catalyst ink and adding to that a liquid copolymer, see page 4 line 23 through page 5 line

10, and applying that to one side of a membrane, see page 6 line 19 through page 6 line 24.

(6) Grounds of Rejection

Whether Claim 26 is unpatentable under 35 USC 103(a) as being obvious over Prakash et al. (hereinafter "Prakash").

Whether Claims 19, 20, 25-27, 32 and 33 are unpatentable under 35 USC 103 as being obvious over Grot et al. (hereinafter "Grot") in view of Fleischer et al. (hereinafter "Fleischer") and in view of Kindler.

Whether Claims 21, 22, 29 and 30 are unpatentable under 35 USC 103 as being unpatentable over Grot in view of Fleischer, Kindler, and Cabasso et al. (hereinafter "Cabasso").

Whether Claims 24 and 31 are unpatentable under 35 USC 103 as based on Grot in view of Fleischer, Kindler and Lawrance et al. (hereinafter "Lawrance").

(7) Argument

Claim 26

Claim 26 stands rejected under 35 U.S.C. § 102(e) as allegedly being anticipated by U.S. Patent No. 6,444,343 to Prakash et al. ("Prakash") or, in the alternative, under 35 U.S.C. § 103(a) as allegedly obvious over Prakash. These rejections are respectfully traversed.

35 U.S.C. § 102(e)

The Office Action contends that the claimed product-by-process limitations do not give patentable weight to the claimed subject matter because the limitations do not give breadth or scope to the product claim. Applicants respectfully disagree.

The Office Action failed to show that Prakash discloses each and every element of the claimed subject matter. "[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself." *In re Thorpe*, 777 F.2d 695, 697 (Fed. Cir. 1985). Thus, "[a product-by-process] claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987). Furthermore, the structure implied by the process steps should be considered when assessing the patentability of product-by-process claims over the prior art. *See, e.g., In re Garnero*, 412 F.2d 276, 279 (C.C.P.A. 1979) (holding "interbonded by interfusion" to limit structure of the claimed composite).

Claim 26 recites "[a] fuel cell containing a membrane electrode assembly, wherein the membrane electrode assembly is

made by the process of: providing a catalyst ink containing a catalytic material, and poly(vinylidene fluoride), adding to the catalyst ink a second ionomer comprising a liquid copolymer of tetrafluoroethylene and perfluorovinylethersulfonic acid; applying the catalyst ink to at least one side of a PSSA-PVDF membrane; and bonding the membrane to at least one electrode." These process steps indicate that the catalyst ink contains PVDF. Therefore, this structure must be considered in assessing the patentability of the claimed subject matter. *See, e.g., In re Garnero*, 412 F.2d at 279.

Prakash does not teach a catalyst ink that contains PVDF. Instead, Prakash discloses catalyst electrodes prepared using electrocatalyst, NAFION® H and an aqueous solution of fluorinated polyethylene (PTFE) applied to PTFE-treated porous carbon paper or directly deposited on PSSA-PVDF membranes. Prakash, col. 8, lines 54-60. Although Prakash's membrane is partially comprised of PVDF, the disclosure makes clear that Prakash's catalyst ink does not contain PVDF, as implied by the claimed process steps.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the anticipation rejection.

Rebuttal to Rejection under 35 U.S.C. § 103(a)

In the alternative, the Office Action contends that Claim 26 is obvious over Prakash. Applicants respectfully traverse this rejection.

The Office Action fails to show how Prakash teaches or suggests all limitations of the claimed subject matter. Applicant respectfully notes that Examiner bears the initial burden of factually supporting any prima facie conclusion of obviousness. MPEP 2142. To establish a prima facie case of obviousness, each claim limitation must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981 (C.C.P.A. 1947); MPEP 2143.03. Although Prakash teaches a fuel cell comprising a catalyzed membrane electrode assembly with a PSSA/PVDF membrane, the catalyst ink present in said membrane electrode assembly does not include PVDF.

Nevertheless, the Office Action is understood to contend that the presence of PVDF in Prakash's membrane renders the claimed subject matter obvious. Applicants respectfully disagree.

Prakash's teaching of the use of PVDF as an inert matrix in a membrane does not suggest the use of PVDF as an ionomer in a catalyst ink because the respective reasons for doing so are entirely different. Prakash teaches that the reason PVDF should

be added to the membrane is to serve as an efficient inert matrix material that forms a useful backbone into which PSSA mixtures are impregnated to produce interpenetrating polymer networks. Prakash, col. 6, line 63 et. seq. In contrast, Applicant's disclosure teaches that the reason PVDF should be added to the catalyst ink is to improve the miscibility between the polymers in the catalyst ink and the membrane and lower fuel crossover through the anode structure into the membrane. Specification, page 5, lines 15-17. Thus, Prakash provides no motivation to use PVDF in the catalyst ink, as recited in Claim 26. Consequently, Applicants respectfully submit that the claimed subject matter is not obvious over Prakash and that finding otherwise requires improper hindsight reasoning.

Furthermore, Applicants respectfully disagree with the Office Action's contention that the fuel cell taught by Prakash is the same as that claimed by Applicants. Indeed, the difference between a fuel cell comprising a catalyzed membrane electrode assembly with a PSSA-PVDF membrane having a catalyst ink that does not contain PVDF and a fuel cell comprising a catalyzed membrane electrode assembly with a PSSA-PVDF membrane having a catalyst ink that does contain PVDF is not insubstantial. Fuel cells having a catalyst ink containing PVDF demonstrate improved interfacial bonding characteristics, which

improves the electrical performance and reduces the impedance compared to membrane electrode assemblies having conventional inks that do not contain PVDF, i.e. the catalyst ink used by Prakash. Specification, page 2, lines 22-25. Furthermore, PVDF has a low intrinsic permeability to methanol and its inclusion in the catalyst ink results in lower crossover through the anode structure into the membrane, vis-à-vis conventional catalyst inks. *Id.*

Accordingly, Applicants respectfully request reconsideration and withdraw of the obviousness rejection.

Rejection of Claims 19, 20, 25-27, 32, and 33

Claims 19, 20, 25-27, 32, and 33 stand rejected under 35 U.S.C. § 103(a) over U.S. Patent No. 5,919,583 to Grot et al. ("Grot") in view of U.S. Patent No. 5,643,689 to Fleisher et al. ("Fleisher") and U.S. Patent No. 5,992,008 to Kindler ("Kindler"). Applicants respectfully traverse this rejection.

An invention is obvious when "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." 35 U.S.C. § 103(a). This inquiry is governed by the objective

standard identified in *Graham v. John Deere Co.*, 383 U.S. 1 (1996).

Applicants respectfully submit that the Office Action improperly concludes that Fleisher would motivate a person of ordinary skill in the art to combine a PVDF with PSSA to make a PSSA-PVDF membrane. *See W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540 (Fed. Cir. 1983)(holding that a prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention). Considered as a whole, Fleisher teaches selecting a matrix polymer such that, when the membrane is contacted with a solvent (preferably water), the membrane swells and, as a result, the electrical contact between the anode plate and/or the cathode plate and the membrane improves. Fleisher, col. 2, lines 30-37. However, Applicants' specification clearly states that PSSA-PVDF membranes do not swell significantly in water. Consequently, based on Fleisher's teachings, a person of ordinary skill would not be motivated to select PSSA and PVDF from Fleisher's list of matrix polymers and acidic multimers to make a PSSA-PVDF membrane.

Even if a person of ordinary skill in the art would be motivated by Fleisher to make PSSA-PVDF membranes, which Applicants do not concede, there is no suggestion or motivation

to combine the teachings of Grot and Fleisher. It is well established that, if the proposed modification or combination of the cited reference would change the principle of operation of the cited reference being modified, then the teachings of the reference are not sufficient to render the claims prima facie obvious. *In re Ratti*, 270 F.2d 810 (C.C.P.A. 1959).

Applicants respectfully submit that the proposed combination of Grot et al. and Fleisher et al. is insufficient to render the claimed subject matter prima facie obvious. Grot teaches the use of a membrane having interstices filled with an inorganic filler in an organic fuel cell. According to the principle of operation of Grot, an inorganic filler is required to fill the interstices of a polymer membrane to slow or block organic fuels such as methanol from diffusing through a membrane. Grot, col. 10, lines 47-51.

The claimed subject matter teaches a membrane electrode assembly for a fuel cell, comprising: a catalyst ink comprising a catalytic material, PVDF, and a second ionomer comprising a liquid copolymer of tetrafluoroethylene and perfluorovinylethersulfonic acid; a PSSA-PVDF membrane; and at least one electrode, as recited in claims 19, 26, and 27. According to the principle of operation of the claimed subject matter, PSSA-PVDF membranes alone, or in combination with a

catalyst ink containing PVDF, result in decreased methanol crossover rates due to the low intrinsic permeability of PVDF to methanol.

Consequently, replacing the membrane containing inorganic filler taught by Grot with the PSSA-PVDF membrane of Fleisher would change the basic principle of operation of Grot's technology. Instead of using inorganic filler to slow or block diffusion of fuel through the membrane, the proposed modification would completely eliminate the presence of inorganic fillers in the membrane and, therefore, completely eliminate Grot's basic principle of operation. Such a change in the principle of operation would require substantial reconstruction and redesign of the elements shown by Grot. Therefore, the combined teachings of Grot and Fleisher are not sufficient to render the claimed subject matter prima facie obvious.

Kindler, which is only cited because it discloses a catalyst ink containing NAFION®, does not remedy the deficiencies of Grot et al. and Fleisher et al. Therefore, the combination of Grot with Fleisher and Kindler does not teach or suggest the use of PVDF in a catalyst ink containing a catalytic material and a second ionomer comprising a liquid copolymer of tetrafluoro-

ethylene and perfluorovinylethersulfonic acid, as recited in Claims 19, 26, and 27.

Applicants note that Claims 20, 25, 32, and 33 are dependent claims that depend from Claims 19 and 27. Since the cited references fail to describe the subject matter of the independent claims from which Claims 20, 25, 32, and 33 depend, the rejection of the dependent claims must fail as well. *See In re Fine*, 837 F.2d 1071 (holding that if an independent claim is nonobvious under 35 U.S.C. § 103, then any claim depending therefrom is nonobvious).

Accordingly, Applicants respectfully request reconsideration and withdrawal of the obviousness rejection.

Rejection of Claims 21, 22, 29, and 30

Claims 21, 22, 29, and 30 stand rejected under 35 U.S.C. §103(a) over Grot in view of Fleisher, Kindler and U.S. Patent No. 5,783,325 to Cabasso et al. ("Cabasso"). Applicants respectfully traverse this rejection.

Claims 21, 22, 29, and 30 are dependent claims that depend from Claims 19 and 27. Since Grot, Fleisher, and Kindler fail to describe the subject matter of the independent claims from which Claims 21, 22, 29, and 30 depend, the rejection of the dependent

claims must fail as well. *See In re Fine*, 837 F.2d 1071. No further argument based upon Cabasso is needed.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the obviousness rejection.

Rejection of Claims 24 and 31

Claims 24 and 31 stand rejected under 35 U.S.C. § 103(a) over Grot in view of Fleisher, Kindler and U.S. Patent No. 4,272,353 to Lawrance et al. ("Lawrance").

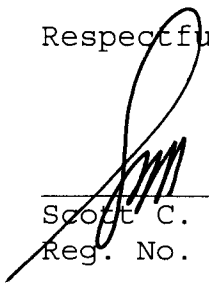
Claims 24 and 31 are dependent claims that depend from Claims 19 and 27 and further define the catalyst ink and the membrane used in the independent claims. Since Grot et al., Fleisher et al., and Kindler fail to describe the subject matter of the independent claims from which Claims 24 and 31 depend, the rejection of the dependent claims must fail as well. *See In re Fine*, 837 F.2d 1071. No further argument based upon Lawrance is needed.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the obviousness rejection.

Applicants ask that all claims be allowed. Please apply the $250 brief fee, the $60 one month extension of time fee, and

any other applicable charges or credits, to Deposit Account No. 06-1050.

Respectfully submitted,



Date: November 13, 2006

Scott C. Harris
Reg. No. 32,030

Fish & Richardson P.C.
PTO Customer No. 20985
12390 El Camino Real
San Diego, California 92130
Telephone: (858) 678-5070
Facsimile: (858) 678-5099

10683196.doc

Appendix of Claims

1-18. (Cancelled).

19. (Previously presented) A process for making a membrane electrode assembly for a fuel cell, comprising:

(a) providing a catalyst ink comprising a catalytic material, and poly(vinylidene fluoride), adding to the catalyst ink a second ionomer comprising a liquid copolymer of tetrafluoroethylene and perfluorovinylethersulfonic acid;

(b) applying the catalyst ink to at least one side of a PSSA-PVDF membrane; and

(c) bonding the membrane to at least one electrode.

20. (Previously presented) The process of claim 19, wherein the membrane is bonded to the electrode at a temperature of greater than about 180 °C.

21. (Previously presented) The process of claim 19, wherein the catalyst ink further comprises a plasticizer.

22. (Previously presented) The process of claim 21, wherein the plasticizer is N,N dimethylacetamide.

23. (Canceled).

24. (Previously presented) The process of claim 19, further comprising roughening a surface of the membrane prior to applying the catalyst ink.

25. (Previously presented) The process of claim 19, wherein the electrode comprises a catalyst layer comprising a catalytic material selected from Pt, Pt/Ru and an ionomer.

26. (Previously presented) A fuel cell comprising a membrane electrode assembly, wherein the membrane electrode assembly is made by the process of:

(a) providing a catalyst ink comprising a catalytic material, and poly(vinylidene fluoride), adding to the catalyst ink a second ionomer comprising a liquid copolymer of tetrafluoroethylene and perfluorovinylethersulfonic acid;

(b) applying the catalyst ink to at least one side of a PSSA-PVDF membrane; and

(c) bonding the membrane to at least one electrode.

27. (Previously presented) A process for making an electrode for a fuel cell, comprising:

(a) providing a catalyst ink comprising a catalytic material, and poly(vinylidene fluoride), adding to the catalyst ink a second ionomer comprising a liquid copolymer of tetrafluoroethylene and perfluorovinylethersulfonic acid; and

(b) applying the catalyst ink to at least one side of a PSSA-PVDF membrane.

28. (Cancelled).

29. (Previously presented) The process of claim 27, wherein the ink further comprises a plasticizer.

30. (Previously presented) The process of claim 29, wherein the plasticizer is N,N dimethylacetamide.

31. (Previously presented) The process of claim 27, further comprising roughening a surface of the membrane prior to applying the catalyst ink.

32. (Previously presented) A process as in claim 19, wherein said providing comprises providing the poly(vinylidene) fluoride in a powder form, and providing the copolymer in a liquid form.

33. (Previously presented) A process as in claim 27, wherein said providing comprises providing said poly(vinylidene) fluoride in a powder form, and providing said copolymer in a liquid form.

Evidence Appendix

None.

Related Proceedings Appendix

None.